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1994-95 School Year

Science 30 Information Bulletin

Diploma Examinations Program

Students First!
Student Evaluation

Alberta
EDUCATION

This document was written primarily for:

Students	✓
Teachers	✓ Science 30 teachers
Administrators	✓
Parents	
General Audience	
Others	

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Purpose of the Bulletin

The purpose of science bulletins is to provide students and teachers of the sciences with information about the diploma examinations scheduled for 1995. Science bulletins include descriptions of the examinations in the sciences that will be administered in January, June, and August of 1995; they outline the objectives to be tested and provide information about the design of the examinations. They provide guidelines for completing the machine-scored answer sheets, use of calculators, and the manipulation of data. Definitions of directing words, which are used to convey expectations for students' responses to exam questions, are given in the appendices along with suggestions for students when preparing for writing diploma examinations.

The bulletins describe the acceptable standard and the standard of excellence for Biology 30, Chemistry 30, Physics 30, and Science 30. These descriptions will give readers a general impression of the levels of achievement expected of students in each of the 30-level science courses.

The revised courses in Biology 30, Chemistry 30, and Physics 30 are being implemented this school year (1994–95). The revisions in these courses have implications for the design of the corresponding diploma examinations. Specific information concerning achievement expectations, sample questions, scoring criteria, and sample answers are provided in the bulletin for each of these courses.

The new Science 30 course is also being implemented this school year. All schools that offer the Science 30 course will be provided with year-end pilot tests. These tests will be prototypes of the Science 30 diploma examinations that will be administered starting the following school year (1995–96). Specific information concerning achievement expectations, sample questions, scoring criteria, and sample answers are provided in this bulletin.

The Science 30 year-end pilot tests will be written according to the 1995 Diploma Examination Schedule, scored in the schools, and then returned to Alberta Education. The students' final course marks will be awarded by the school and will incorporate a 25% minimum weighting of the pilot test score. Students' marks on year-end pilot tests will not be reported separately to Information Services.

Inservices and Presentations

On a limited basis and subject to budget constraints, Student Evaluation Branch staff is available to provide inservices or presentations related to diploma examinations or the interpretation of diploma examination results.

If you have requests, questions, or comments about the contents of this bulletin, please contact:

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General Information

1995 Grade 12 Diploma ExaminationsSchedule

Date	*Time**	*Examination*
Thurs., Jan. 26	9:00–11:30 A.M.	Biology 30
	1:00–3:30 P.M.	Physics 30
Fri., Jan. 27	9:00–11:30 A.M.	Chemistry 30
	1:00–3:30 P.M.	Science 30 Pilot
Tues., June 27	9:00–11:30 A.M.	Biology 30
	1:00–3:30 P.M.	Physics 30
Wed., June 28	9:00–11:30 A.M.	Chemistry 30
	1:00–3:30 P.M.	Science 30 Pilot
Tues., Aug. 15	1:00–3:30 P.M.	Chemistry 30
Wed., Aug. 16	1:00–3:30 P.M.	Science 30 Pilot
Thurs., Aug. 17	9:00–11:30 A.M.	Biology 30
	1:00–3:30 P.M.	Physics 30

*The diploma examinations are designed for a writing time of 2.5 hours. Students will have an additional 0.5 h to complete the examinations.

There are no changes to the examination requirements. It is expected that 2.5 hours is adequate for each examination; however, the extra 0.5 hour is available for those students who need it.

1995 Marking Information

The written-response questions of the diploma examinations in the sciences are marked by classroom teachers. These markers are selected from teachers who have been recommended by their superintendents. To qualify for recommendation in all subjects except Science 30, a teacher must have taught the subject for two or more years, be currently teaching the subject, and have an Alberta Permanent Professional Certificate.

For Science 30, a teacher must have taught the subject previously or be currently teaching the subject, and have a valid Alberta Permanent Professional Certificate.

The following criteria are considered when markers are selected for a particular marking session:

- experience as a marker (generally, first-time markers are given priority)
- regional representation (by zone, jurisdiction, and school)
- student population (proportional representation)
- gender balance

We particularly need teachers who can mark examinations written in French.

Teachers who wish to be recommended as markers for the January 1995 examinations should contact their superintendents before October 1, 1994. Teachers who wish to be recommended as markers for the June and August 1995 examinations should contact their superintendents before March 1, 1995.

Tentative dates for marking of the 1995 science diploma examinations are:

January Administration	February 7 to 11
June Administration	July 10 to 14
August Administration	August 18 to 19

1994–95 Field Testing and Item Writing

As the need arises for teachers to participate in field testing and item writing, letters are sent to superintendents requesting their nominations. Teachers who are interested in these activities should let their superintendents know early in the school term.

Format of the Sciences Examinations

All examinations in the four sciences have both machine-scored questions and teacher-scored (written-response) questions.

The machine-scored questions are of two types: multiple-choice and numerical-response. Please refer to the *Science 30 Information* section of this bulletin for further details about numerical-response questions.

Each examination in the sciences has two written-response questions. At least one of these will be an open-response question. Students' answers to open-response questions are scored by teachers using holistic scoring guides. These guides describe the characteristics of students' answers that correspond to one of five values: 0, 1, 2, 3, or 4. Each student's answer is scored independently by two teachers. The two sub-scores are added together for a combined total raw score.

The other written-response question on each examination may be a closed-response question. Students' answers to closed-response questions are scored by teachers using analytical scoring keys. Each student's answer is scored by only one teacher.

Examination questions are organized into related sets. A set may be introduced by a general scenario that serves as an organizer for one or more contexts. This introductory statement will be screened.

A set of questions may contain multiple-choice and/or numerical-response and/or written-response questions.

If required, a screened bar will indicate the end of a set.

A separate data booklet is provided for the Chemistry 30 and Science 30 (Pilot) examinations. The Biology 30 and Physics 30 examinations contain tear-out data pages. All examinations in the four sciences have tear-out pages for rough work.

Assessment of Skills and STS Connections

Students' understanding of the concepts of science are measured by every question on the examinations. In addition, some questions measure the students' development of the skills and thinking processes associated with scientific inquiry. Some questions will measure students' understanding of the interrelationships between science and technology and among science, technology, and society.

Communication skills are assessed most directly in the teacher-scored questions. For some closed-response questions, in addition to the analytical scoring key, a separate holistic scoring guide may be used. For the open-response questions, the descriptions used in the holistic scoring guides may include criteria for assessing communication skills along with criteria for the other components. Examples of scoring criteria can be found on pages 37 and 38.

The term *communication skills* includes those processes by which information is exchanged through appropriate conventions. These conventions include:

- words, sentences, paragraphs
- graphs, diagrams
- mathematical formulas, mathematical and chemical equations
- significant digits, units of measurement

Conventions that are considered appropriate for a particular response are subject- and question-specific.

Standards

Standards in education are statements that communicate the level of performance necessary to attain a specific goal or objective. Standards assist educators in determining the extent to which students must know content and demonstrate required skills to pass the course.

Standards of student achievement are described in general at the beginning of the *Science 30 Information* section. These standards are applicable to students who attain the *acceptable* standard (a final mark of 50% or higher) and to students who attain the standard of *excellence* (a final mark of 80% or higher).

A more detailed description of specific learner expectations (standards) accompanied by sample questions, answers, scoring criteria, and samples of student responses is given in the *Sample Test Items, Scoring Criteria, and Sample Answers* section.

Use of Scientific Calculators on Examinations

Examinations are constructed to ensure that the use of particular scientific calculators neither advantages nor disadvantages individual students.

Please refer to Appendix A for the policy statement on the use of scientific calculators on diploma examinations. Also consult the *Science 30 Information* section. Students should be made aware of this policy as early as possible in the school term to ensure they are able to use the scientific calculator of their choice when writing examinations.

Students should also be made aware of the Examination Rules, Grade 12 Diploma Examinations (see Appendix B). Students should know that notes stored in electronic devices may not be brought into the examination room.

Rescores

A student may request a rescoring of the diploma examination if he or she believes that the mark received is not appropriate. However, before applying for a rescoring, it is important to check the distribution of marks in the examination. The machine-scored mark is not likely to change as a result of a rescore, but the written-response mark could change slightly. Students should remember that the rescored mark will be the final mark whether it *increases* or *decreases*.

Examiners' Reports

Following the administration of the January and June examinations, examiners' reports are released. These reports briefly outline the statistical data obtained from the examination administration and provide a diagnostic overview of student performance. Examiners' reports are designed for teacher use. If we can make these reports more useful to you, please let us know.

School and Jurisdiction Statistical Reports

Superintendents and principals receive detailed statistical reports on how well the students in their school district did on the sciences examinations. Teachers use these data to reflect on the areas of the program where their students did well and those areas where student performance was poor.

Annual Report

A document entitled *Annual Report, Diploma Examination Program,* that summarizes results from the January, June, and August diploma examination administrations is published each year. The purpose of this report is to inform educators and the public about student achievement in relation to provincial standards.

Science 30 Information

Standards

Students who attain an *acceptable* standard of performance in Science 30 can state or solve multistep problems. They are able to correctly answer questions involving concepts from a particular area of science. These students are able to follow correct laboratory procedures when given specific directions. They can make the connection between science concepts and laboratory activities when the data are used to verify known information. Drawing a graph from experimental data or reading values from a graph does not present a problem for these students. They can use science knowledge to explain the operation of various technologies studied in Science 30. They are also able to present arguments about societal issues such as environmental concerns and ethical issues related to Science 30 material.

Students who attain a standard of *excellence* in Science 30 have gained knowledge and abilities that allow them to be literate in a broad range of science areas. Such students can integrate concepts from many areas of science. They demonstrate creativity and flexibility and can solve multistep problems. They are able to design or refine laboratory procedures to demonstrate science principles or solve science problems. They can critically analyze scientific studies, including the associated charts, graphs, and conclusions. These students are aware of the variety of viewpoints relating to the environmental and ethical issues in the field of science and technology. They are able to clearly express their opinions about these issues.

Examination Design

The design of the 1994 Science 30 year-end examinations will include multiple-choice, numerical-response, and written-response questions.

Part	Response Format	Question Format	Marks	Weighting (%)
A	Selected	Multiple Choice (44)	44	55%
	Created	Numeric Response (12)	12	15%
B	Created	Written Response (2)	24	30%

Most questions will include contextual material. In some cases, a series of questions will be developed around a single scenario. This will reduce the amount of text necessary for each question. It will also lead to an integration of questions from all the units of the course.

The written response section will consist of two questions, each with value of 12 marks. Together they will account for 30% of the total examination mark. These questions will have an emphasis on technological concepts, the nature of science, and science and society issues. They will require students to outline and defend positions on STS issues or to describe technologies of their own choosing. Because of the "open-endedness" of these questions, descriptive scales will be used to mark student responses.

Examination Specifications

Each Science 30 Diploma Examination is designed to reflect the Science 30 Course General Learner Expectations outlined in the *Science 20-30 Program of Studies, Interim, for Senior High Schools*. The general learner expectations are expressed in more detail by the specific learner expectations, which are organized in four units. Some questions on each diploma exam will assess achievement of specific learner expectations and some will be based on the integration of the specific learner expectations.

Knowledge ***Emphasis***

The student can:

- show how the body maintains **equilibrium** with its environment through the interaction of the nervous, circulatory, and immune **systems**
  Unit 1 Major Concepts 1 to 3 (17%)
- show the role of DNA in maintaining **equilibrium**
  Unit 1, Major Concept 4 (7%)
- classify and describe **systems** (categories) of **matter** including acids, bases, and organic compounds based on their chemical characteristics and their impact on the environment
  Unit 2, Major Concept 1 to 3 (26%)
- demonstrate a knowledge of the **diversity** (similarities and differences) in the properties of gravitational, electrical, and magnetic fields
  Unit 3, Major Concept 1 and 2 (14%)
- demonstrate an understanding of the properties of the electromagnetic spectrum (**energy**), including the use of these properties in studying the history and structure of the universe
  Unit 3, Major Concept 3 and 4 (10%)
- demonstrate an understanding of the sources of usable energy and the environmental impacts of various **systems** (forms) of energy production and use
  Unit 4, Major Concept 1 to 4 (26%)

Skills ***Emphasis***

The student can: 40–60%

- design, interpret, explain, analyze, and evaluate investigations
- organize data into tables, graphs, and diagrams and predict relationships
- interpret, explain, analyze, and evaluate data to infer relationships
- use appropriate scientific terminology and mathematical language to communicate and explain scientific concepts

Connections Among Science, Technology, and Society (STS) ***Emphasis***

The student can: 15–35%

- apply cause-and-effect reasoning to formulate relationships in which scientific evidence shapes or refutes a theory, and can explain the limitations of science and technology in answering all questions and solving all problems
- describe and evaluate the design and function of technological solutions to theoretical and practical problems, and relate the ways in which science and technology advance one another
- evaluate from a variety of perspectives how science and technology are influenced and supported by society, and assess the ability to interact responsibly with the environment
- apply the skills and knowledge acquired in science to everyday life

Sample Examination, Scoring Criteria, and Sample Answers

This year-end examination was administered to 250 students in the pilot study schools in January 1994. The answer and the difficulty for each question is given. (For example, a difficulty of 0.356 indicates that 35.6% of the 250 pilot students responded correctly.) The questions on the examination were not previously field tested, so some of them may be flawed.

The examination was developed according to the examination specifications on page 6.

Sample Examination

Science 30

Grade 12 Year-End Examination

Description

Time: 2.5 h. You may take an additional 0.5 h to complete the examination.

Total possible marks: 80

This is a **closed-book** examination consisting of parts:

- 44 multiple-choice and 12 numerical response questions each with a value of one mark.
- 2 written-response questions for a total of 24 marks.

This examination contains sets of related questions. A set of questions may contain multiple-choice and/or numerical-response and/or written response questions.

A Science data booklet is provided for your reference.

Instructions

- Fill in the information required on the answer sheet and the examination booklet as directed by the presiding examiner.
- You are expected to provide your own scientific calculator.
- Consider all numbers used in the examination to be the result of a measurement or observation.
- Carefully read the instructions for each type of question before proceeding.
- The presiding examiner will collect your answer sheet and examination booklet and send them to Alberta Education.
- Do not fold the answer sheet.

Multiple Choice

- Use an HB pencil only for the machine-scored answer sheet.
- If you wish to change an answer, erase all traces of your first answer.
- Decide which of the choices **best** completes the statement or answers thequestion.
- Locate that question number on the separate answer sheet provided and fill in the circle that corresponds to your choice.

Example

This examination is for the subject of

A. chemistry
B. biology
C. physics
D. science

Answer Sheet

● Ⓑ Ⓒ Ⓓ

Numerical Response

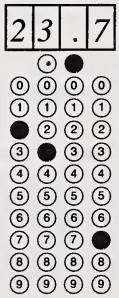
- Read each question carefully.
- Record your answer on the answer sheet provided by writing it in the boxes and then filling in the corresponding circles.
- Use an HB pencil only for the machine-scored answer sheet.
- If you wish to change an answer, erase all traces of your first answer.
- **Enter the first digit of your answer in the left-hand box and leave any unused boxes blank.**

Examples
Calculation Question and Solution

The average of the values 21.0, 25.5, and 24.5 is ________.
(Record your answer to three digits.)

Average = (21.0 + 25.5 + 24.5)/3
= 23.666
= 23.7 (rounded to three digits)

Record 23.7 on the answer sheet ⟶



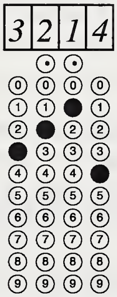
Correct-order Question and Solution

When the following subjects are arranged in alphabetical order, the order is________. (Record all four digits.)

1 physics
2 chemistry
3 biology
4 science

Answer 3, 2, 1, 4

Record 3214 on the answer sheet ⟶



Written Response

- Write your answers in the examination booklet as neatly as possible.
- For full marks, your answers **must show all** pertinent explanations, calculations, and formulas.
- Your answers **should be** presented in a well-organized manner using complete sentences for a written response, and correct units and significant digits for a numeric response.

Note: *The perforated pages at the backof this booklet may be torn outandused for your rough work.* ***Nomarks*** *will begiven for work doneonthe tear-out pages.*

Do not turn the page to start the test until told to do so by the presiding examiner.

Jo leaves Edmonton to go on a family skiing holiday in the mountains at Marmot Basin, near Jasper, Alberta.

Answer: B
Difficulty – 0.407
(Excellence)
Unit: 1
Major concept: 1
Concept: 3

1. On the first day of her ski holiday, Jo is surprised to find herself out of breath after only a few ski runs. Which of the following statements **best** accounts for this condition?

A. Metabolic rate is decreased as a result of the colder temperature and the altitude change.

B. Oxygen absorption into the circulatory system is decreased due to lower atmospheric pressure.

C. Increased pressure at high altitudes causes constriction of arterial walls resulting in increased heart rate.

D. Decreased pressure at high altitudes causes the lungs to be less effective in their expansion and contraction.

Answer: B
Difficulty – 0.581
(Acceptable)
Unit: 1
Major Concept: 1
Concept: 2

2. Jo experienced low blood oxygen levels when she first arrived on the mountain, but a week later her blood oxygen levels were higher. Her body adjusted to the lower amounts of oxygen in the atmosphere at high altitude by increasing

A. the amount of blood glucose per millilitre of blood

B. the number of erythrocytes (red blood cells) per millilitre of blood

C. the number of leukocytes (white blood cells) per millilitre of blood

D. the number of erythrocytes, leukocytes, and platelets per millilitre of blood

Answer: B
Difficulty – 0.457
(Excellence)
Unit: 2
Major concept: 1
Concept: 11

3. As a Science 30 student, Jo is concerned about acid deposition. A snow sample has a pH of 6.5. Jo proposes explanations for the observed pH. Which explanation is **most** reasonable?

A. The slightly basic pH represents clean air.

B. The slightly acidic pH represents clean air.

C. The acidic pH indicates that a pollution source must be upwind.

D. The basic pH indicates that a pollution source must be upwind.

4. Jo's ski instructor shows her how to do all the parts of a ski turn as separate, distinct actions. "With practice, you will put them together, until turns become a reflex," says her instructor. What is **wrong** with the ski instructor's use of scientific terminology?

Answer: A
Difficulty – 0.872
(Acceptable)
Unit: 1
Major Concept: 3
Concept: 5

A. A reflex is not a learned response.

B. A reflex only occurs to a single muscle fibre.

C. A reflex does not use motor neuron pathways.

D. A reflex can only be taught before the age of six.

5. Jo's instructor recommends that polarizing sun glasses be worn at all times when on the ski hill. What is the **benefit** of wearing polarized lenses?

Answer: D
Difficulty – 0.667
(Acceptable)
Unit: 3
Major concept: 3
Concept: 6

A. They reflect so well that the wearer has better depth perception.

B. The refraction of solar radiation by snow and ice inverts the polarized rays.

C. The absorption of solar radiation by the air and snow leaves only polarized light.

D. The reflection of solar radiation is mainly in one plane so the glare off the snow is lessened.

6. Jo had lunch in the ski lodge. When she leaves the low light level of the restaurant and steps into the bright outside light, which **eye structure** changes in response to the change in light levels?

Answer: A
Difficulty – 0.380
(Acceptable)
Unit: 1
Major concept: 3
Concept: 1

A. The iris enlarges to reduce pupil size.

B. The pupil shrinks to reduce lens size.

C. The lens shrinks to reduce retina size.

D. The retina shrinks to reduce iris size.

Answer: C
Difficulty – 0.841
(Acceptable)
Unit: 1
Major concept: 1
Concept: 3

7. Jo visits the ski patrol hut and talks with Pat, the head of the ski patrol. Pat tells her that some minor injuries can be life-threatening if shock sets in because there will be a drastic drop in blood pressure.

The danger of low blood pressure is that

A. too much blood fills the heart
B. too much blood stays in the kidney
C. insufficient oxygen reaches the brain
D. insufficient lymph forms in the lungs

Answer: D
Difficulty – 0.411
(Excellence)
Unit: 1
Major concept: 3
Concept: 4

8. Concerned that the bindings that hold the boots to her skis are improperly adjusted, Jo visits the ski technician in the repair shop. The technician adjusts the bindings to release at a setting determined by Jo's height, weight, and ability level. This control mechanism is analogous to our nervous system in that the release of the binding is like the

A. repolarizing of a neuron
B. graduated response of a neuron
C. refractory period of a neuron
D. all-or-none response of a neuron

Answer: B
Difficulty – 0.632
(Acceptable)
Unit: 3
Major concept: 2
Concept: 7

9. The ski lift operates with 220 V electric motors, but the power grid coming to the ski resort has a potential difference of 25 000 V. The transformer needed to make this change would have a theoretical ratio of turns in the primary coil to turns in the secondary coil of

A. 0.0088:1
B. 114:1
C. 2 421:1
D. 24 780:1

Use the following statements to answer question 10.

I The angle of the sun changes at higher altitudes
II Ultraviolet radiation is reflected from the snow
III There is less atmosphere to absorb ultraviolet radiation
IV Exercise increases blood circulation to the face so sunburn occurs more readily

10. A skier in the mountains is advised to wear sunscreen with a higher sun protection factor than would normally be required. This advice is best supported by which two statements?

A. I and III
B. I and IV
C. II and III
D. II and IV

Answer: C
Difficulty – 0.690
(Acceptable)
Unit: 3
Major concept: 3
Concept: 5

Zap, a character in a science fiction novel, is shrunk to platelet size and injected into a patient's bloodstream. While on his mission, he has the unique opportunity to observe various structures of the circulatory system.

Numerical Response

1. Zap is injected into a vein of the arm. Select the correct pathway through which he travels, starting at the point in the arm.

1 – large, thick-walled, muscular vessel
2 – tiny, thin-walled vessels
3 – very large, cavernous structure with extremely thick, muscular walls
4 – thin-walled vessels with back-flow valves

Answer:

______	______	______	______
First structure	Second structure	Third structure	Fourth structure

(Record your answer in the numerical-response section of the answer sheet.)

Answer: 4312
Difficulty – 0.128
(Excellence)
Unit: 1
Major concept: 1
Concept: 1

Answer: C
Difficulty – 0.477
(Excellence)
Unit: 1
Major concept: 1
Concept: 1

11. Zap's wrist computer gives him the following printout analysis of his current surroundings.

Blood Analysis	
colour	bright red
glucose	high
carbon dioxide	low
blood pressure	low

Zap is in

A. a vein leading from the brain
B. an artery leading to the heart
C. a vein leading from the lung
D. an artery leading to the lung

Answer: B
Difficulty – 0.589
Note: This question does not fit the revised *Program of Studies*.

12. When Zap passes through the brain, his passage disturbs the patient's muscle coordination. Which structure is being affected?

A. Cerebral cortex
B. Cerebellum
C. Medulla oblongata
D. Hypothalamus

13. While Zap is in a muscle capillary, the patient begins to run on a treadmill. The muscle begins to produce large amounts of carbon dioxide. The carbon dioxide reacts with water in the patient's blood as shown in the chemical reaction:

$$CO_{2(g)} + H_2O_{(l)} \rightarrow H_2CO_{3(aq)}$$

$$H_2CO_{3(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + HCO_3{}^-_{(aq)}$$

Zap's wrist computer tells him that the H_3O^+ concentration is 6.2×10^{-8} mol/L. What is the pH of the patient's blood?

A. 6.3
B. 7.2
C. 8.1
D. 9.2

Answer: B
Difficulty – 0.589
(Acceptable)
Unit: 2
Major concept: 1
Concept: 4

Numerical Response

2. Zap's wrist computer warns of an attack by the immune system. The patient's body is reacting to Zap as a foreign substance. Arrange these immune system responses in the correct order.

1 – antibodies are produced
2 – macrophage develops antigen marker
3 – helper T-cells identify antigen
4 – suppressor T-cells act on immune systems

Answer:

________ ________ ________ ________

(Record your answer in the numerical-response section of the answer sheet.)

Answer: 2314
Difficulty – 0.221
(Acceptable)
Unit: 1
Major concept: 2
Concept: 2

14. Which type of immune cell might try to engulf Zap?

A. Macrophage
B. Antibody
C. Suppressor T-cell
D. B-cell

Answer: A
Difficulty – 0.419
(Acceptable)
Unit: 1
Major concept: 2
Concept: 2

You are hired to do an environmental impact study in a highly industrialized area of Alberta.

Answer: C
Difficulty – 0.329
(Acceptable)
Unit: 2
Major concept: 2
Concept: 2

15. Sour gas plants and refineries release $H_2S_{(g)}$ and $SO_{2(g)}$ into the air. What result would you expect when testing the soil in the vicinity of these industries?

A. Raised pH to the east of the plant
B. Raised pH to the west of the plant
C. Lowered pH to the east of the plant
D. Lowered pH to the west of the plant

Answer: A
Difficulty – 0.678
(Acceptable)
Unit: 2
Major concept: 1
Concept: 11

16. Acid deposition could be reduced by

A. using low sulphur-content coal for fuel
B. less reliance on hydroelectric power
C. cloud seeding to increase rainfall
D. reducing the use of CFCs

Answer: A
Difficulty – 0.636
(Acceptable)
Unit: 2
Major concept: 1
Concept: 6

17. You observe that an area experienced rain having an average pH of 4.5 but that the pH of the soil did not change enough to affect plant growth. The best explanation is that the

A. soil has a good buffering capacity
B. acid was not completely dissociated
C. plants were resistant to an increase in pH
D. soil had a high concentration of hydronium ions

Numerical Response

3. You titrated a 50.0 mL sample of rain water with 15.0 mL of a 0.010 mol/L NaOH solution. What was the H_3O^+ concentration of the rain water? Assume all acid is in the form of $H_3O^+_{(aq)}$. Express your answer to three digits.

Answer: ______________ $\times 10^{-3}$ mol/L.

(Record your answer in the numerical-response section of the answer sheet.)

Answer: 3.00
Difficulty – 0.140
(Excellence)
Unit: 2
Major concept: 1
Concept: 10

18. You test the water in a nearby ditch. You record your results as follows:

Indicator Evidence	
phenolphthalein	colourless
bromothymol blue	yellow
methyl orange	red
methyl violet	blue

You estimate the pH of the water to be

A. 2.4
B. 3.2
C. 4.6
D. 7.1

Answer: A
Difficulty – 0.291
(Excellence)
Unit: 2
Major concept: 1
Concept: 9

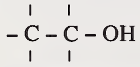
Use the following information to answer question 19.

A petrochemical industry produces vinyl chloride and ethanol from ethane. Vinyl chloride is used to produce plastics. Ethanol is used as a gasoline additive.

Answer: B
Difficulty – 0.740
(Acceptable)
Unit: 2
Major concept: 3
Concept: 1

19. Which category name and chemical formula identifies ethanol?

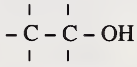
A.



$$-\overset{|}{\underset{|}{C}}-\overset{|}{\underset{|}{C}}-OH$$

Carbonyl

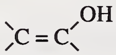
B.



$$-\overset{|}{\underset{|}{C}}-\overset{|}{\underset{|}{C}}-OH$$

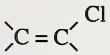
Alcohol

C.



Alcohol

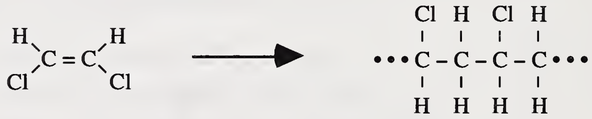
D.



Alcohol

Use the following information to answer question 20.

Vinyl Chloride to Plastic



Answer: C
Difficulty – 0.488
(Acceptable)
Unit: 2
Major concept: 3
Concept: 2

20. Which type of reaction is shown?

A. Substitution
B. Decomposition
C. Polymerization
D. Hydrocarbon combustion

21. Synthetic hydrocarbons are usually a greater pollution hazard than natural organic substances because synthetic hydrocarbons are

A. more volatile
B. less water soluble
C. less biodegradable
D. more chemically reactive

Answer: C
Difficulty – 0.628
(Acceptable)
Unit: 2
Major concept: 3
Concept: 4

Use the following information to answer questions 22 to 23.

Safety Data Sheet for Vinyl Chloride

- human carcinogen
- boiling point of 13.4°C
- insoluble in water

22. On a calm summer day, there is an accidental release of vinyl chloride. What would you monitor first to determine the severity of the problem?

A. Air
B. Soil
C. Water
D. Sewage

Answer: A
Difficulty – 0.450
(Acceptable)
Unit: 2
Major concept: 3
Concept: 1
(Skill A)

23. Exposure to carcinogens increases the risk of developing cancer. Cancer is characterized by uncontrolled cell division. In humans, vinyl chloride would **most** likely affect

A. DNA functioning
B. blood pressure control
C. bicarbonate buffering
D. nerve impulse transmission

Answer: A
Difficulty – 0.562
(Excellence)
Unit 1
Major Concept: 4
Concept: 4

Answer: 4132
Difficulty – 0.535
(Acceptable)
Unit: 2
Major concept: 2
Concept: 1

Numerical Response

4. Match these sources of pollution with the pollutants listed by writing the numbers in the appropriate blanks.

1 – vehicle exhaust
2 – coal burning
3 – leaching by acidic run-off
4 – propellants and refrigerants

Pollutants: _____ CFCs _____ NO_x _____ heavy metals _____ SO_2

Use the following information to answer questions 24 to 26.

Effects of Pollutants

I An increase in exposure to ultraviolet radiation
II An increase in acid rain
III Decreased ozone levels
IV An accumulation in the body
V Increased ozone levels

Answer: C
Difficulty – 0.891
(Acceptable)
Unit: 2
Major concept: 2
Concept: 3

24. CFCs result in

A. II only
B. IV only
C. I and III only
D. I and V only

Answer: B
Difficulty – 0.640
(Acceptable)
Unit: 2
Major concept: 2
Concept: 1

25. Nitrogen oxides result in

A. I only
B. II only
C. I and V only
D. II and V only

26. SO_2 results in

A. I only
B. II only
C. I and V only
D. II and V only

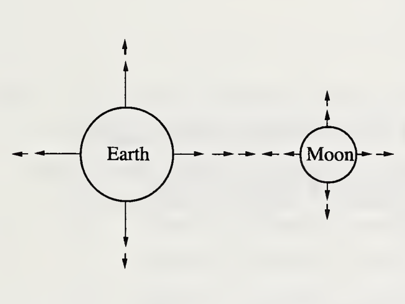
Answer: B
Difficulty – 0.678
(Acceptable)
Unit: 2
Major concept: 1
Concept: 1

By the year 1999, the United States space agency, NASA, is scheduled to have a space station in a geosynchronous orbit around Earth's equator. One of the difficulties that will be encountered in placing such a huge mass in space is the problem of overcoming various gravitational, magnetic, and electric fields.

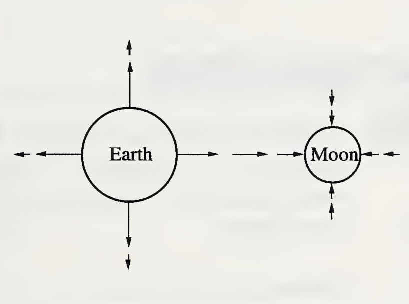
27. Which diagram **best** depicts the gravitational fields between Earth and the moon?

Answer – D
Difficulty – 0.651
(Acceptable)
Unit: 3
Major concept: 1
Concept: 3

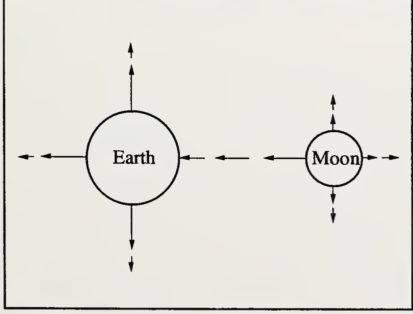
A.



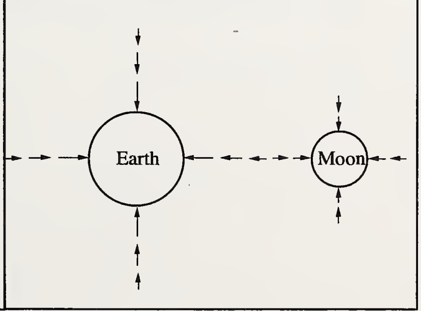
B.



C.



D.



Answer: 9.53
Difficulty – 0.128
(Acceptable)
Unit: 3
Major concept: 1
Concept: 1
(Skill C)

Numerical Response

5. The space station is placed 6.47×10^6 m from the centre of Earth. Calculate the strength of the gravitational field due to the Earth at this point. Express your answer to three digits.

Answer: ______________ N/kg.

(Record your answer in the numerical-response section of the answer sheet.)

Answer: D
Difficulty – 0.578
(Acceptable)
Unit: 3
Major concept: 1
Concept: 3

28. The gravitational fields of Earth and the moon could exert a force on the space station, causing it to eventually spiral to the surface of Earth or the moon. One possible method of avoiding this would be to situate the station at a point in space of "zero" net gravitational field. This point between Earth and the moon would be

A. midway
B. non-existent
C. closer to Earth
D. closer to the moon

Answer: 1.26
Difficulty – 0.163
(Acceptable)
Unit: 3
Major concept: 3
Concept: 3

Numerical Response

6. Scientists in the space station 3.77×10^8 m from the surface of Earth send a radio signal to Mission Control on Earth. How long will it take for the signal to reach Earth? Express your answer to three digits.

Answer: __________s.

(Record your answer in the numerical-response section of the answer sheet.)

Numerical Response

7. Scientists decide to power the space station by using silicon photovoltaic cell panels to capture the solar energy radiated by the sun. The solar energy available at this point in space is 3.20×10^3 J/m^2 per second. How much energy is available for capture by a 1.00 m × 1.50 m panel in one second? Express your answer to three digits.

Answer: __________ $\times 10^3$ J.

(Record your answer in the numerical-response section of the answer sheet.)

Answer: 4.80
Difficulty – 0.287
(Acceptable)
Unit: 4
Major concept: 2
Concept: 2

Numerical Response

8. If the current through a 240 W solar panel is 0.500 A, what is the voltage generated by this panel. Express your answer to three digits.

Answer: __________ V.

(Record your answer in the numerical-response section of the answer sheet.)

Answer: 480
Difficulty – 0.233
(Acceptable)
Unit: 3
Major concept: 2
Concept: 2
(Skill C)

29. The electrical energy from one solar panel is 24 V, 10.0 A. How can 120 V, 10.0 A be produced?

- **A.** Connect 5 panels in series
- **B.** Connect 5 panels in parallel
- **C.** Connect 12 panels in series
- **D.** Connect 12 panels in parallel

Answer: A
Difficulty – 0.492
(Acceptable)
Unit: 3
Major concept: 2
Concept: 3
(Skill E)

Answer: 2858
Difficulty – 0.039
(Excellence)
Unit: 4
Major concept: 2
Concept: 5

Numerical Response

9. The scientists on the space station decide to replenish their oxygen supply by using the electrolysis of water.

$$2H_2O_{(l)} \xrightarrow{\text{electrical energy}} 2H_{2(g)} + O_{2(g)}$$

Use heats of formation to determine how much electrical energy must be supplied to produce 10.00 moles of $O_{2(g)}$. Express your answer to four digits.

Answer: __________ kJ.

(Record your answer in the numerical-response section of the answer sheet.)

In order to determine the feasibility of using an alternative energy source, it must be tried on a small scale. You have been commissioned to develop a self-sufficient station. You will be responsible to produce all of your energy requirements from what is available to you. Sources of energy will be determined by the location.

The next five questions deal with the following location.

Your first possible location is in the mountains, where there is a fast-moving stream, hot springs, solar radiation, and biomass.

Answer: D
Difficulty – 0.221
(Acceptable)
Unit: 4
Major concept: 3
Concept: 1

30. Which of these processes generates geothermal energy?

A. Convection currents in mantle material
B. Fossil fuel combustion
C. Plate tectonic friction
D. Radioactive decay

31. Which of the available energy sources at this location would produce $CO_{2(g)}$ as a byproduct?

A. Biomass
B. Geothermal
C. Solar power
D. Hydroelectric

Answer: A
Difficulty – 0.558
(Acceptable)
Note: This question does not fit the revised *Program of Studies*
Unit: 4
Major concept: 1
Concept: 4

32. What energy source drives the water cycle?

A. Geothermal heating
B. Ocean currents
C. Gravitation
D. Sun

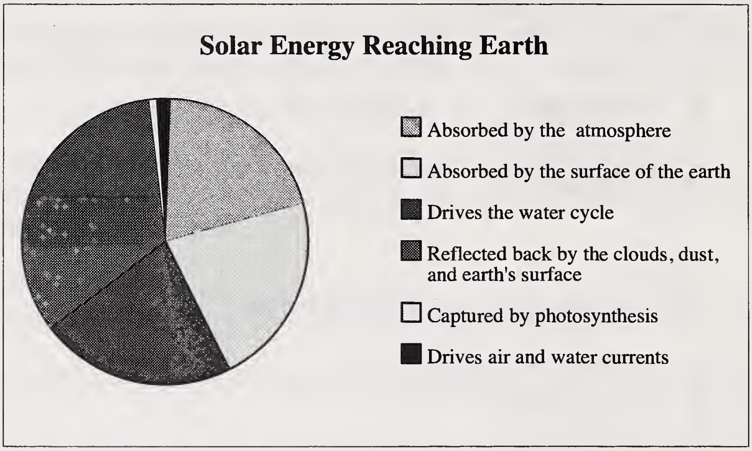
Answer: D
Difficulty – 0.508
(Acceptable)
Unit: 4
Major concept: 2
Concept: 1

33. Energy is produced on the sun through the process of

A. fusion
B. fission
C. combustion
D. photosynthesis

Answer: A
Difficulty – 0.500
(Acceptable)
Unit: 4
Major concept: 3
Concept: 3

Use the following diagram to answer numerical response question 10.



Answer: 2314
Difficulty – 0.267
(Acceptable)
Note: The low performance on this question was probably due to the lack of clarity in the diagram.
Unit: 4
Major concept: 2
Concept: 2

Numerical Response

10. Rank the following according to increasing use of solar radiation.

1 – driving the water cycle
2 – initiating photosynthesis
3 – driving air and water currents
4 – reflected by clouds, dust, and earth's surface

Answer:

________ ________ ________ ________

(Record your answer in the numerical-response section of the answer sheet.)

The next four questions deal with the following location.

> The second possible location for your self-sufficient station is on the prairies where the available energy sources are wind, solar radiation, and biomass.

34. The generation of wind power originates in

A. the sun
B. magnetic fields
C. electrical fields
D. gravitational fields

Answer: A
Difficulty – 0.453
(Acceptable)
Unit: 4
Major concept: 2
Concept: 3

Numerical Response

Use the following information to answer numerical response question 11.

> **Energy conversions**
> 1 – thermal
> 2 – solar
> 3 – electrical
> 4 – mechanical

11. List the sequence of energy conversions used to generate electricity from wind.

Answer:

________ ________ ________ ________

(Record your answer in the numerical-response section of the answer sheet.)

Answer: 2143
Difficulty – 0.450
(Excellence)
Unit: 4
Major concept: 2
Concept: 2

35. Which environmental impact would you give the highest priority when recommending the construction of a wind-powered electrical station in a residential area?

A. Electrical transmission lines will emit EMR
B. The metal blades would appear unattractive
C. Interference with radio communications
D. Noise pollution

Answer: D
Difficulty – 0.233
(Acceptable)
Note: poor question
Unit: 4
Major concept: 1
Concept: 4

Answer: D
Difficulty – 0.109
(Excellence)
Unit: 4
Major concept: 1
Concept: 4

36. Currently, the lowest mean annual wind speed from which turbines can economically extract energy is about 5 m/s. Given that the wind energy varies directly as the cube of the wind speed, a mean annual wind speed of 10 m/s would multiply the amount of energy available by

A. 2
B. 3
C. 6
D. 8

The next three questions deal with the following information.

> Biomass may provide energy directly through combustion or indirectly through fermentation into methane that is then burned.

Answer: C
Difficulty – 0.519
(Acceptable)
Unit: 4
Major concept: 2
Concept: 5

37. What is the molar heat of combustion for methane based on the reaction equation $1\ CH_{4(g)} + 2\ O_{2(g)} \rightarrow 1\ CO_{2(g)} + 2HO_{2(g)}$?

A. –560.5 kJ/mol
B. –710.1 kJ/mol
C. –802.3 kJ/mol
D. –951.9 kJ/mol

Answer: 6238
Difficulty – 0.043
(Excellence)
Unit: 4
Major concept: 2
Concept: 5

Numerical Response

12. How much useful energy would be released if 10.00 mol of methane was burned in a mid-efficiency (78%) furnace. Express your answer to four digits.

Answer: ____________ kJ.

(Record your answer in the numerical-response section of the answer sheet.)

38. Which energy conversion pathway is most efficient in providing hot water?

- **A.** Solar to thermal
- **B.** Wind to electrical to thermal
- **C.** Combustion of coal to hydroelectric to thermal
- **D.** Methane production (composting) to methane combustion to thermal

Answer: A
Difficulty – 0.391
(Excellence)
Unit: 4
Major concept: 2
Concept: 2

The next four questions deal with the following location.

> The third possible location for the alternate energy station is a coastal region. In this location, tides and solar radiation would be the available energy sources.

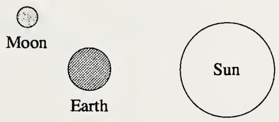
39. The generation of tides can **best** be explained by

- **A.** inertia of water
- **B.** centrifugal force
- **C.** electrostatic fields
- **D.** gravitational fields

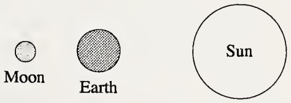
Answer: D
Difficulty – 0.760
(Acceptable)
Unit: 4
Major concept: 4
Concept: 1

40. Twice a month, a spring tide (very high and very low water levels) occurs. Which diagram explains this event?

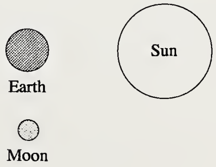
A.



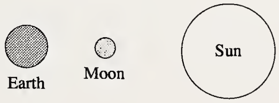
B.



C.



D.



Answer: D
Difficulty – 0.496
(Answer – D)
(Acceptable)
Note: Poor question. The configuration in B would also result in a spring tide.
Unit: 4
Major concept: 4
Concept: 1

Answer: A
Difficulty – 0.554
(Acceptable)
Unit: 4
Major concept: 4
Concept: 1

41. The sun and moon interact to produce tides. Which has the greater influence?

A. The moon because it is closer
B. The sun because of its greater mass
C. Equal influence because of size and distance
D. The moon because it is solid rather than gaseous in nature

Answer: D
Difficulty – 0.566
(Excellence)
Unit: 4
Major concept: 4
Concept: 2

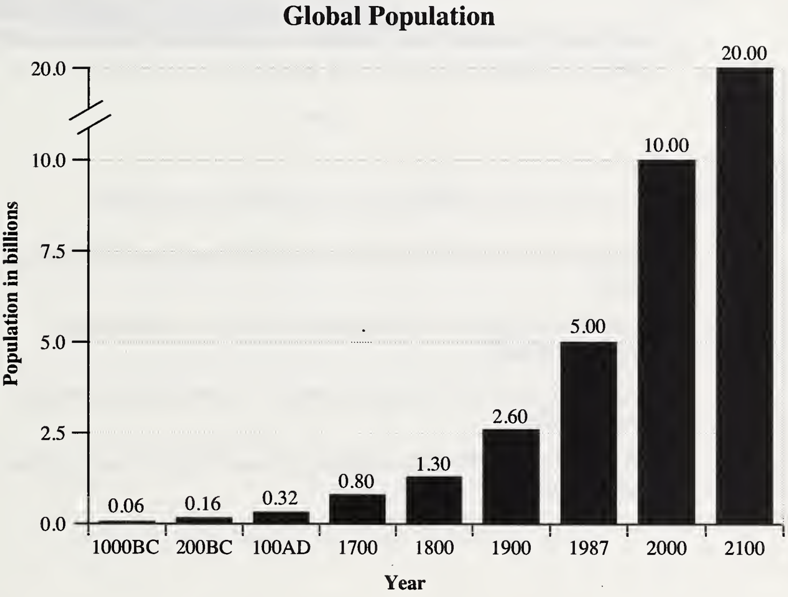
42. Which path **best** represents the conversion of tidal energy into electrical energy?

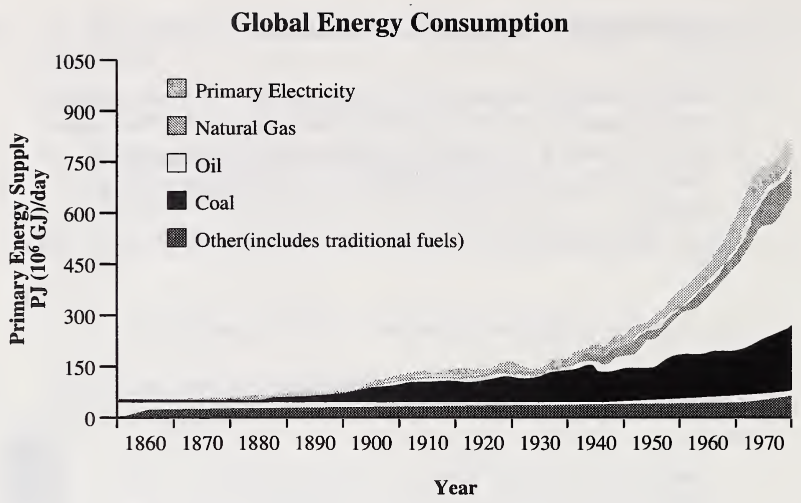
A. Solar → kinetic (water) → mechanical → electrical
B. Gravitational potential → kinetic (water) → thermal → electrical
C. Geothermal → kinetic (water) → mechanical → thermal → electrical
D. Gravitational potential → kinetic (water) → mechanical → electrical

Use the following information to answer question 43.

Global energy consumption, population growth, and pollution have become growing concerns for most people. You have been hired as a consultant for Alternative Environmental Energy Ltd. to reduce dependence on conventional energy sources.

Use the following graphs to answer question 43.





Answer: D
Difficulty – 0.519
(Acceptable)
Unit: 4
Major concept: 1
Concept: 1

43. From the information in the graphs, one can conclude that

A. both population growth and energy consumption have grown linearly

B. as population grows exponentially, energy consumption increases linearly

C. as population grows linearly, energy consumption increases exponentially

D. both population growth and energy consumption have grown exponentially

---

Answer: B
Difficulty – 0.465
(Acceptable)
Unit: 4
Major concept: 1
Concept: 1

44. The most significant reason that per capita energy consumption has increased is

A. population growth

B. increased industrialization

C. less efficient use of available energy

D. the discovery and development of new energy sources

Use the following information to answer the next question.

Genetic technologies offer many benefits while presenting challenging ethical questions.

Written Response

1. Provide an example of genetic technology that has had or that you think will have an impact on society, and describe one social or ethical issue associated with it. Outline the risks and benefits involved, and present an argument for how you think society should deal with this technology.

Unit: 1

Use the following information to answer the next question.

The electromagnetic radiation (EMR) emitted by celestial bodies can be detected by various technologies. Evidence from this work has been used to support several theories of the history and structure of the universe.

Written Response

Unit: 3

2. Describe one theory or model of the universe. Describe a technology that is used to gather information about the universe. Explain how the information gathered supports the model or theory that you provided.

Scoring Criteria for the Written-Response Questions

Scoring Guide—January 1994 Exam Written Response 1

CONCEPTS

Score	Scoring Descriptions
4 Standard of Excellence	The description of a genetic technology is accurate, complete, and well organized. Science concepts presented in the discussion of ethical issues are correct. The risks and benefits associated with the use of the technology are thoroughly described and appropriate examples are listed.
3	The description of a genetic technology is mostly accurate, complete, and organized. Science concepts presented in the discussion of ethical issues are mostly correct. The risk and benefits associated with the use of the technology are described in detail and examples are listed.
2 Acceptable Standard	The description of a genetic technology is generally accurate and complete but may be somewhat disorganized. Science concepts presented in the discussion of ethical issues are generally correct. The risks and benefits associated with the use of the technology are described and examples are listed.
1	The description of a genetic technology is vague, lacking, and disorganized. Science concepts presented in the discussion of ethical issues are inaccurate. Few risks and benefits associated with the use of the technology are described.
0	The response does not address any of the major points of the question.

STS

Score	Scoring Descriptions
4 Standard of Excellence	Relevant ethical issues and examples are identified and interrelationships are explicit. The risks and benefits are carefully chosen and effectively support the opinions presented. The plan for future use of the technology is creative, practical, and effectively presents the student's point-of-view.
3	Relevant ethical issues and examples are identified and interrelationships are evident. The risks and benefits are appropriate and support the opinions presented. The plan for future use of the technology effectively presents the student's point-of-view.
2 Acceptable Standard	Relevant ethical issues and examples are identified and interrelationships are shown. The risks and benefits chosen generally support the opinions presented. The plan for future use of the technology presents the student's point-of-view.
1	Ethical issues and examples are identified but few interrelationships are shown. The risks and benefits chosen do not support the opinions presented. The plan for future use of the technology is confused or inappropriate.
0	The response does not address any of the major points of the question.

Scoring Guide—January 1994 Exam Written Response 2

CONCEPTS

Score	Scoring Descriptions
4 Standard of Excellence	The description of a theory or model is accurate and complete. The relevant technology is thoroughly described. The explanation of how the theory or model is supported by the information gained through the technology is correct and explicit. The response is well organized and addresses all the major points of the question.
3	The description of a theory or model is mostly accurate and complete. The relevant technology is correctly described. The explanation of how the theory or model is supported by the information gained through the technology is correct and explicit. The response is organized and addresses most of the major points of the question.
2 Acceptable Standard	The description of a theory or model is generally accurate and complete. The relevant technology is described. The explanation of how the theory or model is supported by the information gained through the technology is correct and explicit. The response addresses some of the major points of the question.
1	The description of a theory or model is inaccurate and incomplete. The relevant technology is lacking. The explanation of how the theory or model is supported by the information gained through the technology is correct and explicit. The response addresses few of the major points of the question.
0	The response does not address any of the major points of the question.

Sample Answers to the Written-Response Questions

Written-Response Question 1

An example of a genetic technology is genetic screening. Scientists can study chromosomes from tissue and discover many of the genetic traits for the individual from which it was taken. Included in these traits are susceptibility to diseases such as sickle cell anemia, cystic fibrosis, Down's syndrome.

Genetic screening may provide many benefits by giving a warning for diseases that may occur in the future. The individual may then be prepared medically or emotionally for the future. For example, it is now becoming possible to identify women who are susceptible to breast cancer. These women may choose to have a mastectomy if their risk is high. Embryos and fetuses may also be screened and the life of the baby saved because of the advance notice of disease.

Another advantage of knowing the genetic code that is responsible for particular defects is that treatments may be devised for some of the diseases. Genetic therapy is already being tried with diseases such as SKIDS, multiple sclerosis, and overproduction of cholesterol. Another strategy for treatment is to develop chemicals that are missing because of defective genes and administer them to affected patients.

Many of the risks associated with this technology can be discussed in terms of the related ethical issues. The ethical issue that arises from this technology relates to how the information gained from these procedures is to be used. Decisions about which fetuses live and die might be made on the basis of their genetic makeup. This is already happening with severely debilitating diseases like Down's syndrome. Embryo implantation may be decided on the genetic desirability of the offspring. Who will decide the point at which a parent or physician can make a decision to terminate pregnancy or which embryos should be implanted?

I think that this type of technology should be stringently regulated on a global basis. Its use to research and cure diseases should probably continue. Other uses need to be discussed before going further. I do not think that pregnancies should be ended except when there is danger to the mother or the fetus has little chance of survival. This opinion is based on my belief in the sanctity of human life.

Written-Response Question 2

One theory of the universe is the Big Bang theory. This theory suggests that the universe consisted of a huge ball of matter (mostly protons) that exploded with great force. Some of the matter was turned into energy and much of it was flung into space.

One of the technologies that gathers evidence about the universe is a spectrometer. This instrument measures the EMS from bodies in space. Analysis of spectra from stars and galaxies indicates a shift in their spectra toward the red end (red shift). Not only does this indicate that all bodies in the universe are receding from each other but the more distant the body the faster it is receding. This evidence supports the idea that all the matter is moving away from a center that may have been the origin of the Big Bang. The degree of red shifting is consistent with how far these distant objects should be in a universe that is 16 to 18 billion years old. Other evidence supports this as the age of the universe.

Radio telescopes and instruments that measure microwaves record background radiation coming from all regions of space. This energy is about the same amount that would be predicted from the big bang explosion.

Standards with Examples

The Curriculum Standards provided in this section are intended to clarify the *Science 30 Course of Studies* statements. Included in this section are examples of questions that students must be able to do to demonstrate *acceptable* or *excellent* achievement. All sample questions are taken from the Science 30 January 1994 Year-End examination.

Knowledge #1 Unit 1—Major Concepts 1–3: Circulatory, Nervous, and Immune Systems

The student can show how the body maintains *equilibrium* with its *environment* through the interactions of the nervous, circulatory, and immune *systems*. (Approximate Weighting 17%)

The student demonstrating *acceptable* achievement can:

- describe the structure and function of the circulatory system and the role of blood components
- describe the body's defense against disease including the functioning of the immune system
- describe the structure and function of the organs of sight and balance, neurons, and the central and peripheral nervous systems

The student achieving the *standard of excellence* can also:

- explain the interconnections among and within the circulatory, immune, and nervous systems
- give clear explanations about the role of negative feedback and other control mechanisms in the regulation of the circulatory, immune, and nervous systems
- apply knowledge of these systems to solve novel problems

The student achieving the *acceptable standard* can correctly answer the following types of questions:

Multiple Choice 2 **Difficulty – 0.581**

Jo experienced low blood oxygen levels when she first arrived on the mountain, but a week later her blood oxygen levels were higher. Her body adjusted to the lower amounts of oxygen in the atmosphere at high altitude by increasing

A. the amount of blood glucose per millilitre of blood
***B.** the number of erythrocytes (red blood cells) per millilitre of blood
C. the number of leukocytes (white blood cells) per millilitre of blood
D. the number of erythrocytes, leukocytes, and platelets per millilitre of blood

Multiple Choice 4 **Difficulty – 0.872**

Jo's ski instructor shows her how to do all the parts of a ski turn as separate, distinct actions. "With practice, you will put them together, until turns become a reflex," says her instructor. What is **wrong** with the ski instructor's use of scientific terminology?

***A.** A reflex is not a learned response.
B. A reflex only occurs to a single muscle fibre.
C. A reflex does not use motor neuron pathways.
D. A reflex can only be taught before the age of six.

Multiple Choice 6 **Difficulty – 0.380**

Jo had lunch in the ski lodge. When she leaves the low light level of the restaurant and steps into the bright outside light, which **eye structure** changes in response to the change in light levels?

*A. The iris enlarges to reduce pupil size.
B. The pupil shrinks to reduce lens size.
C. The lens shrinks to reduce retina size.
D. The retina shrinks to reduce iris size.

Multiple Choice 7 **Difficulty – 0.841**

Jo visits the ski patrol hut and talks with Pat, the head of the ski patrol. Pat tells her that some minor injuries can be life-threatening if shock sets in because there will be a drastic drop in blood pressure.

The danger of low blood pressure is that

A. too much blood fills the heart
B. too much blood stays in the kidney
*C. insufficient oxygen reaches the brain
D. insufficient lymph forms in the lungs

Numerical Response 2 **Difficulty – 0.221**

Zap's wrist computer warns of an attack by the immune system. The patient's body is reacting to Zap as a foreign substance. Arrange these immune system responses in the correct order.

1 – antibodies are produced
2 – macrophage develops antigen marker
3 – helper T-cells identify antigen
4 – suppressor T-cells act on immune systems

Answer:

________ ________ ________ ________

(Record your answer in the numerical-response section of the answer sheet.)

Answer – 2314

Multiple Choice 14 **Difficulty – 0.419**

Which type of immune cell might try to engulf Zap?

*A. Macrophage
B. Antibody
C. Suppressor T-cell
D. B-cell

The student achieving the *standard of excellence* can do the following types of questions:

Multiple Choice 1 **Difficulty – 0.407**

On the first day of her ski holiday, Jo is surprised to find herself out of breath after only a few ski runs. Which of the following statements **best** accounts for this condition?

A. Metabolic rate is decreased as a result of the colder temperature and the altitude change.

***B.** Oxygen absorption into the circulatory system is decreased due to lower atmospheric pressure.

C. Increased pressure at high altitudes causes constriction of arterial walls resulting in increased heart rate.

D. Decreased pressure at high altitudes causes the lungs to be less effective in their expansion and contraction.

Multiple Choice 8 **Difficulty – 0.411**

Concerned that the bindings that hold the boots to her skis are improperly adjusted, Jo visits the ski technician in the repair shop. The technician adjusts the bindings to release at a setting determined by Jo's height, weight, and ability level. This control mechanism is analogous to our nervous system in that the release of the binding is like the

A. repolarizing of a neuron
B. graduated response of a neuron
C. refractory period of a neuron
***D.** all-or-none response of a neuron

Numerical Response 1 **Difficulty – 0.128**

Zap is injected into a vein of the arm. Select the correct pathway through which he travels, starting at the point in the arm.

1 – large, thick-walled, muscular vessel
2 – tiny, thin-walled vessels
3 – very large, cavernous structure with extremely thick, muscular walls
4 – thin-walled vessels with back-flow valves

Answer:

______	______	______	______
First structure	Second structure	Third structure	Fourth structure

(Record your answer in the numerical-response section of the answer sheet.)

Answer – 4312

Multiple Choice 11 **Difficulty – 0.477**

Zap’s wrist computer gives him the following printout analysis of his current surroundings.

Blood Analysis	
colour	bright red
glucose	high
carbon dioxide	low
blood pressure	low

Zap is in

A. a vein leading from the brain
B. an artery leading to the heart
C. a vein leading from the lung
D. an artery leading to the lung

Knowledge #2 Unit 1—Major Concept 4: Genetics

The student can show the role of DNA in maintaining *equilibrium*. (Approximate Weighting 7%)

The student achieving the *acceptable standard* can:

- explain the principles of heredity including dominance, recessiveness, meiosis, mitosis, fertilization, sex-linkage, and non-disjunction
- describe, in general terms, the structure and function of DNA and its involvement in forming proteins
- describe genetic technologies and their impact on society

The student achieving the *standard of excellent* can also:

- relate the function and structure of DNA to the principles of heredity
- provide several points-of-view on the use of genetic technologies and their impact on society
- apply knowledge of genetics to solve novel problems

The student achieving the *acceptable standard* can do the following types of questions:

Use the following information to answer the next question.

> Genetic technologies promise to offer many benefits while presenting challenging ethical questions.

Written Response #1

Provide an example of genetic technology that has had or will have an impact on society and describe one social or ethical issue associated with it. Outline the risks and benefits involved and present an argument for how you think society should deal with this technology.

The following student response demonstrates an *acceptable* level of achievement.

One very major concern in the world of scientific research is the new concept of genetic engineering. This is the process by which certain cells and genes are mapped out in the body and altered. This process can be helpful in that it may help to save a fetus from a mental handicap, or can create a fetus of a person's choice. It can also save a defective gene from being passed on to the next generation. However, it does have its disadvantages. Many people are voicing the issue that "it's not nice to fool Mother Nature." They believe that the way a child is created is how they should remain. This process can also be harmful if it does not result in success. It could harm the fetus more or even kill it. I feel that if it is absolutely necessary to save the fetus' life, or prevent the reproduction of a harmful gene, this process should be followed. However, it must only be if it is absolutely necessary. If it is only for material reasons, this process must not be done as it may harm more than it may help.

Note: The scoring guides for this question appear on page 35.

The student achieving the *standard of excellence* can do the following types of questions:

Use the following information to answer the next question.

Safety Data Sheet for Vinyl Chloride

- human carcinogen
- boiling point of 13.4°C
- insoluble in water

Multiple Choice 23 **Difficulty – 0.562**

Exposure to carcinogens increases the risk of developing cancer. Cancer is characterized by uncontrolled cell division. In humans, vinyl chloride would most likely affect

***A.** DNA functioning
B. blood pressure control
C. bicarbonate buffering
D. nerve impulse transmission

Use the following information to answer the next question.

Genetic technologies offer many benefits while presenting challenging ethical questions.

Written Response #1

Provide an example of genetic technology that has had or that you think will have an impact on society, and describe one social or ethical issue associated with it. Outline the risks and benefits involved, and present an argument for how you think society should deal with this technology.

The following student response demonstrates *excellent* achievement.

Gene mapping is a relatively new technology that has already had a huge impact on society and will continue to do so in the future. Gene mapping has numerous benefits, by discovering what each gene in the human body does we can detect diseases, like M.S. at their earliest stages, try to prevent these diseases, and learn so much about what each individual gene does, and how they relate. The risks question the value of this information, they also pose ethical questions. For example if expecting parents are informed of a danger or possibility of an unhealthy baby, they may change their minds on going through with the pregnancy. Also if gene mapping is successful parents and doctors will have the control to alter influential factors on the newborn. This may all seem quite convenient but currently parents are living without it and are raising M.S. or C.F. for e.g. kids and accepting the challenge. The ethical or social issue associated with this is should man kind have the power to alter, change, or discontinue human life, as they see fit or is it up to a higher power. Some believe a higher power has put us here and should be the only one to influence our creation. Society needs to set limits on how far they'll let this go. We need to realize that man call not be made into a paper doll that doctor and scientists can dress up as they wish. Man is a living feeling being and we can't let medical advancements have us forget that.

Note: The scoring guides for this question appear on page 35.

Knowledge #3 Unit 2—Major Concepts 1–3: Chemistry

The student can classify and describe *systems* (categories) of *matter* including acids, bases, and organic compounds based on their chemical characteristics and their impact on the *environment*. (Approximate Weighting 26%)

The student achieving the *acceptable standard* can:

- describe acids in terms of the hydronium ion concentration, the Brønsted-Lowry principle, and the pH value
- explain the difference between strong acids and concentrated acids
- outline sources of common air and water pollutants and reactions responsible
- explain neutralization and buffering reactions
- use an indicator to determine the end point of a titration and determine the pH of a solution
- outline methods for proper sampling and monitoring of water pollution
- identify members of simple organic families and list their uses
- describe the impact of the pulp and paper industry and of pesticides on the environment

The student achieving the *standard of excellence* can also:

- use titration data to differentiate between strength and concentration of acids
- use two or more indicators to determine a pH range for a solution
- evaluate, from a global perspective, the role of economic, environmental, and social (political) concerns in the use of chemical technology
- explain the relationships among chemistry, energy, and environmental concepts

The student achieving the *acceptable standard* can do the following types of questions:

Multiple Choice 10 **Difficulty – 0.690**

A skier in the mountains is advised to wear sunscreen with a higher sun protection factor than would normally be required. This advice is best supported by which two statements?

A. I and III
B. I and IV
***C.** II and III
D. II and IV

Multiple Choice 13 **Difficulty – 0.589**

While Zap is in a muscle capillary, the patient begins to run on a treadmill. The muscle begins to produce large amounts of carbon dioxide. The carbon dioxide reacts with water in the patient's blood as shown in the chemical reaction:

$$CO_{2(g)} + H_2O_{(l)} \rightarrow H_2CO_{3(aq)}$$

$$H_2CO_{3(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + HCO_3^-{}_{(aq)}$$

Zap's wrist computer tells him that the H_3O^+ concentration is 6.2×10^{-8} mol/L. What is the pH of the patient's blood?

 A. 6.3
*__B.__ 7.2
 C. 8.1
 D. 9.2

Multiple Choice 16 **Difficulty – 0.678**

Acid deposition could be reduced by

*__A.__ using low sulphur-content coal for fuel
 B. less reliance on hydroelectric power
 C. cloud seeding to increase rainfall
 D. reducing the use of CFCs

Multiple Choice 17 **Difficulty – 0.636**

You observe that an area experienced rain having an average pH of 4.5 but that the pH of the soil did not change enough to affect plant growth. The best explanation is that the

*__A.__ soil has a good buffering capacity
 B. acid was not completely dissociated
 C. plants were resistant to an increase in pH
 D. soil had a high concentration of hydronium ions

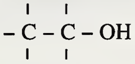
Use the following information to answer the next question.

A petrochemical industry produces vinyl chloride and ethanol from ethane. Vinyl chloride is used to produce plastics. Ethanol is used as a gasoline additive.

Multiple Choice 19 **Difficulty – 0.740**

Which category name and chemical formula identifies ethanol?

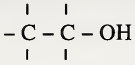
A.



$-\overset{|}{\underset{|}{C}}-\overset{|}{\underset{|}{C}}-OH$

Carbonyl

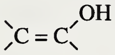
***B.**



$-\overset{|}{\underset{|}{C}}-\overset{|}{\underset{|}{C}}-OH$

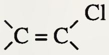
Alcohol

C.



Alcohol

D.

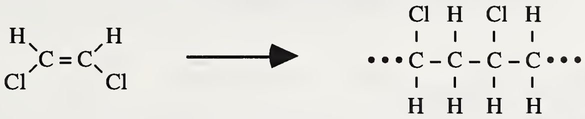


Alcohol

Sci30/Unit4 Q23

Use the following information to answer the next question.

Vinyl Chloride to Plastic



Multiple Choice 20 **Difficulty – 0.488**

Which type of reaction is shown?

A. Substitution
B. Decomposition
***C.** Polymerization
D. Hydrocarbon combustion

Multiple Choice 21 **Difficulty – 0.628**

Synthetic hydrocarbons are usually a greater pollution hazard than natural organic substances because synthetic hydrocarbons are

A. more volatile
B. less water soluble
***C.** less biodegradable
D. more chemically reactive

Use the following information to answer the next question.

Safety Data Sheet for Vinyl Chloride

- human carcinogen
- boiling point of 13.4°C
- insoluble in water

Multiple Choice 22 **Difficulty – 0.450**

On a calm summer day, there is an accidental release of vinyl chloride. What would you monitor first to determine the severity of the problem?

*A. air
B. soil
C. water
D. sewage

Numerical Response 4 **Difficulty – 0.535**

Match these sources of pollution with the pollutants listed by writing the numbers in the appropriate blanks.

1 – vehicle exhaust
2 – coal burning
3 – leaching by acidic run-off
4 – propellants and refrigerants

Pollutants:	____	____	____	____
	CFCs	NO_x	heavy metals	SO_2

Answer – 4132

Use the following information to answer the next three questions.

Effects of Pollutants

I An increase in exposure to ultraviolet radiation
II An increase in acid rain
III Decreased ozone levels
IV An accumulation in the body
V Increased ozone levels

Multiple Choice 24 **Difficulty – 0.891**

CFCs result in

A. II only
B. IV only
*C. I and III only
D. I and V only

Multiple Choice 25 **Difficulty – 0.640**

Nitrogen oxides result in

- **A.** I only
- ***B.** II only
- **C.** I and V only
- **D.** II and V only

Multiple Choice 26 **Difficulty – 0.678**

SO_2 results in

- **A.** I only
- ***B.** II only
- **C.** I and V only
- **D.** II and V only

The student achieving the *standard of excellence* can do the following types of questions:

Multiple Choice 3 **Difficulty – 0.457**

As a Science 30 student, Jo is concerned about acid deposition. A snow sample has a pH of 6.5. Jo proposes explanations for the observed pH. Which explanation is **most** reasonable?

- **A.** The slightly basic pH represents clean air.
- ***B.** The slightly acidic pH represents clean air.
- **C.** The acidic pH indicates that a pollution source must be upwind.
- **D.** The basic pH indicates that a pollution source must be upwind.

Numerical Response 3 **Difficulty – 0.140**

You titrated a 50.0 mL sample of rain water with 15.0 mL of a 0.0100 mol/L NaOH solution. What was the H_3O^+ concentration of the rain water? Assume all acid is in the form of $H_3O^+_{(aq)}$. Express your answer to three digits.

Answer: ______________ $\times 10^{-3}$ mol/L.

(Record your answer in the numerical-response section of the answer sheet.)

Answer – 3.00

Multiple Choice 18 **Difficulty – 0.291**

You test the water in a nearby ditch. You record your results as follows:

Indicator Evidence	
phenolphthalein	colourless
bromothymol blue	yellow
methyl orange	red
methyl violet	blue

You estimate the pH of the water to be

*A. 2.4
B. 3.2
C. 4.6
D. 7.1

Use the following information to answer the next question.

Safety Data Sheet for Vinyl Chloride

- human carcinogen
- boiling point of 13.4°C
- insoluble in water

Multiple Choice 23 **Difficulty – 0.562**

Exposure to carcinogens increases the risk of developing cancer. Cancer is characterized by uncontrolled cell division. In humans, vinyl chloride would most likely affect

*A. DNA functioning
B. blood pressure control
C. bicarbonate buffering
D. nerve impulse transmission

Knowledge #4 Unit 3—Major Concepts 1–2: Field Theory

The student can demonstrate a knowledge of the *diversity* (similarities and differences) in the properties of gravitational, electrical, and magnetic fields. (Approximate Weighting 14%)

The student achieving the *acceptable standard* can:

- explain the properties of scalar and vector fields including shape, direction, distance, strength, and source
- apply the formulas $F_g = \frac{Gm_1m_2}{R^2}$ and $F_e = \frac{kq_1q_2}{R^2}$ to solve one-step problems
- describe the relationship between power, current, voltage, and resistance in parallel and series circuits and use the formulas: $P = VI$, $V = IR$, and $R_T = R_1 + R_2 + R_3$.
- explain the difference between direct and alternating current and their uses
- explain the interaction of magnetic and electrical fields and their use in electric motors, generators, and transformers

The student achieving the *standard of excellence* can also:

- explain how the strength of a field varies with the square of the distance and then graph the relationship
- explain and calculate current, voltage, and resistance when a circuit contains a variety of power sources on resistances connected in series and parallel
- explain the relationship to electricity of heat, chemical, and light energy
- apply the formula $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \cdots$
- apply knowledge of field theory to solve novel problems

The student achieving the *acceptable standard* can do the following types of questions:

Multiple Choice 9 **Difficulty – 0.632**

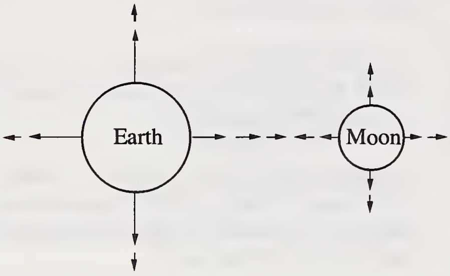
The ski lift operates with 220 V electric motors, but the power grid coming to the ski resort has a potential difference of 25 000 V. The transformer needed to make this change would have a theoretical ratio of turns in the primary coil to turns in the secondary coil of

A. 0.0088:1
***B.** 114:1
C. 2 421:1
D. 24 780:1

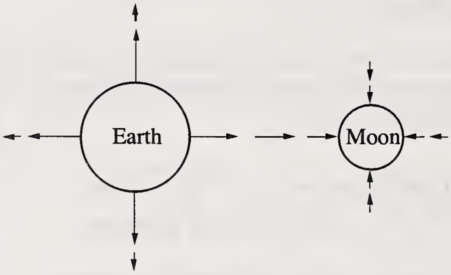
Multiple Choice 27 **Difficulty – 0.651**

Which diagram **best** depicts the gravitational fields between Earth and the moon?

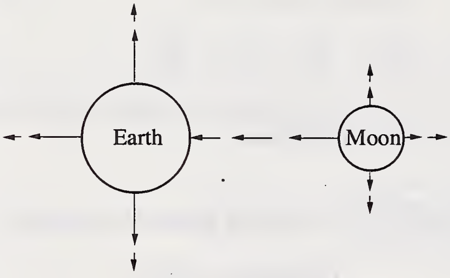
A.



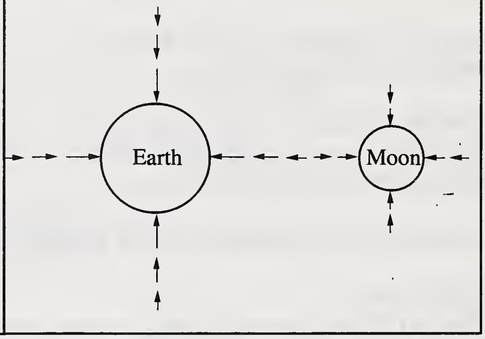
B.



C.



***D.**



Numerical Response 5 **Difficulty – 0.128**

The space station is placed 6.47×10^6 m from the centre of Earth. Calculate the strength of the gravitational field due to the Earth at this point. Express your answer to three digits.

Answer: ______________ N/kg.

(Record your answer in the numerical-response section of the answer sheet.)

Answer – 9.53

Multiple Choice 28 **Difficulty – 0.578**

The gravitational fields of Earth and the moon could exert a force on the space station, causing it to eventually spiral to the surface of Earth or the moon. One possible method of avoiding this would be to situate the station at a point in space of “zero” net gravitational field. This point between Earth and the moon would be

A. midway
B. non-existent
C. closer to Earth
***D.** closer to the moon

Multiple Choice 29 **Difficulty – 0.492**

The electrical energy from one solar panel is 24 V, 10.0 A. How can 120 V, 10.0 A be produced?

***A.** Connect 5 panels in series
B. Connect 5 panels in parallel
C. Connect 12 panels in series
D. Connect 12 panels in parallel

The student achieving the *standard of excellence* can do the following types of questions:

Numerical Response 7 **Difficulty – 0.287**

Scientists decide to power the space station by using silicon photovoltaic cell panels to capture the solar energy radiated by the sun. The solar energy available at this point in space is 3.20×10^3 J/m^2 per second. How much energy is available for capture by a 1.00 m × 1.50 m panel in one second? Express your answer to three digits.

Answer: __________ $\times 10^3$ J.

(Record your answer in the numerical-response section of the answer sheet.)

Answer – 4.80

Knowledge #5 *Unit 3—Major Concepts 3–4: Electromagnetic Spectrum*

The student demonstrates an understanding of the properties of the electromagnetic spectrum (*energy*), including their use in studying the history and structure of the universe. (Approximate Weighting 10%)

The student achieving the *acceptable standard* can:

- explain the composition and propagation of electromagnetic radiation (EMR) in terms of electric and magnetic fields
- describe the properties of EMR in terms of velocity, frequency, amplitude, wavelength, energy, and source
- describe the phenomena of reflection, refraction, and polarization
- describe how the properties of EMR are used in radio and in satellite technology
- describe how radiation from electrical bodies can be analyzed to determine their composition, temperature, and motion, and describe how this analysis can provide evidence for the nature of the universe

The student demonstrating *excellent* achievement can also:

- integrate an understanding of refraction with the principles of spectroscope and explain how this can be used to interpret emission and absorption spectra
- use knowledge of EMR to solve novel problems

The student achieving the *acceptable standard* can do the following types of questions:

Multiple Choice 5 **Difficulty – 0.667**

Jo’s instructor recommends that polarizing sun glasses be worn at all times when on the ski hill. What is the **benefit** of wearing polarized lenses?

A. They reflect so well that the wearer has better depth perception.

B. The refraction of solar radiation by snow and ice inverts the polarized rays.

C. The absorption of solar radiation by the air and snow leaves only polarized light.

***D.** The reflection of solar radiation is mainly in one plane so the glare off the snow is lessened.

Use the following statements to answer question 10.

I The angle of the sun changes at higher altitudes
II Ultraviolet radiation is reflected from the snow
III There is less atmosphere to absorb ultraviolet radiation
IV Exercise increases blood circulation to the face so sunburn occurs more readily

Multiple Choice 10 **Difficulty – 0.690**

A skier in the mountains is advised to wear sunscreen with a higher sun protection factor than would normally be required. This advice is best supported by which two statements?

A. I and III
B. I and IV
***C.** II and III
D. II and IV

Numerical Response 6 **Difficulty – 0.163**

Scientists in the space station 3.77×10^8 m from the surface of Earth send a radio signal to Mission Control on Earth. How long will it take for the signal to reach Earth? Express your answer to three digits.

Answer: __________s.

(Record your answer in the numerical-response section of the answer sheet.)

Answer – 1.26

Multiple Choice 33 **Difficulty – 0.500**

Energy is produced on the sun through the process of

***A.** fusion
B. fission
C. combustion
D. photosynthesis

Use the following information to the next question.

The electromagnetic radiation (EMR) emitted by celestial bodies can be detected by various technologies. Evidence from this work has been used to support several theories of the history and structure of the universe.

Written Response #2

Describe one theory or model of the universe. Describe a technology that is used to gather information about the universe. Explain how the information gathered supports the model or theory that you provided.

The following student response demonstrates an *acceptable* level of achievement.

Scientists believe that the earth was created by what is called the “big bang” theory. It is believed at one time there was a large celestial body and it exploded sending debree throughout the universe. The earth was created from the debree. This theory is supported by the Doppler effect and red shift. The debree is moving further away as time goes on. The rate is increasing as it moves away. The believe that it will shift in and out but there is only evidence to support a continual moving outwards. This evidence supports the “big bang” theory.

Note: The scoring guide for this question appears on page 36.

The student achieving the *standard of excellence* can do the following types of questions:

Use the following information to the next question.

The electromagnetic radiation (EMR) emitted by celestial bodies can be detected by various technologies. Evidence from this work has been used to support several theories of the history and structure of the universe.

Written Response #2

Describe one theory or model of the universe. Describe a technology that is used to gather information about the universe. Explain how the information gathered supports the model or theory that you provided.

The following student response demonstrates *excellent* achievement.

The main technologies used to gather information about the universe is the spectroscope and various types of telescopes. The spectroscope is used to analyzed the radiation from hot objects. Scientists can tell what stars are made of, their temperature and even their motion from analyzing the spectrum.

Scientists have found that stars have a red shift, indicate that they are moving away. The further away a star is the greater its red shift. This shows that they are moving away from a central area.

The Big Bang theory says that gravity pulled mass together which created energy for a huge explosion. The matter was flung into space and continues move outward from the centre. The red shifting measured by spectroscope supports this theory. The amount of red shift is what would be expected from a universe that is about 18 billion years old.

Note: The scoring guide for this question appears on page 36.

Knowledge #6 Unit 4—Major Concepts 1–4: Energy Production and Use

The student can demonstrate an understanding of the sources of usable energy and the *environmental* impacts of various *systems* (forms) of energy production and use. (Approximate Weighting 26%)

The student achieving the *acceptable standard* can:

- list the advantages and disadvantages associated with the following energy sources: solar, wind, geothermal, nuclear, fossil fuel, biomass, tidal, and hydroelectric
- describe the role of mass/energy equivalency in fusion or fission reactions to explain solar radiation and nuclear reactions
- explain the relationship among the gravitational fields of the Earth, moon, and sun, and the formation of tides
- calculate the efficiency of energy conversions ($E = \frac{\text{input}}{\text{output}} \times 100$)

The student achieving the *standard of excellence* can also:

- describe the use of energy sources along with political and environmental considerations to explain the concept of sustainable development
- relate the concepts of chemical energy using Hesse's law and the concepts of electrical energy ($E = Pt$) to determine the efficiency of various energy sources
- use knowledge of energy to solve novel problems

The student achieving the *acceptable standard* can do the following types of questions:

In order to determine the feasibility of using an alternative energy source it must be tried on a small scale. You have been commissioned to develop a self-sufficient station. You will be responsible to produce all of your energy requirements from what is available to you. Sources of energy will be determined by the location.

The next five questions deal with the following location.

Your first possible location is in the mountains, where there is a fast-moving stream, hot springs, solar radiation, and biomass.

Multiple Choice 30 **Difficulty – 0.221**

Which of these processes generates geothermal energy?

A. Convection currents in mantle material
B. Fossil fuel combustion
C. Plate tectonic friction
***D.** Radioactive decay

Multiple Choice 31 **Difficulty – 0.558**

Which of the available energy sources at this location would produce $CO_{2(g)}$ as a byproduct?

***A.** Biomass
B. Geothermal
C. Solar power
D. Hydroelectric

Multiple Choice 32 **Difficulty – 0.508**

What energy source drives the water cycle?

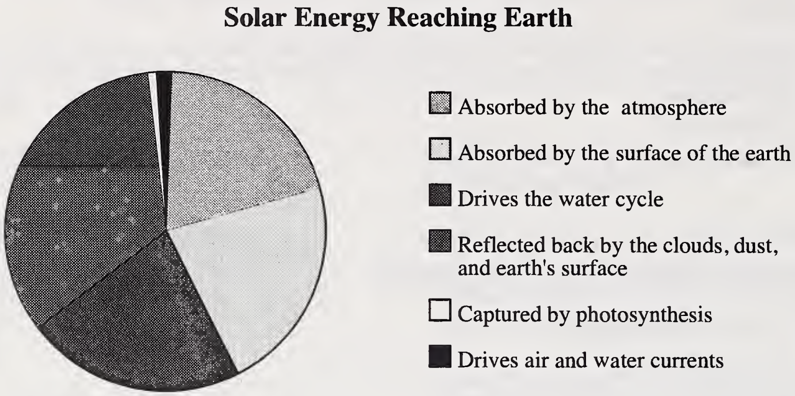
A. Geothermal heating
B. Ocean currents
C. Gravitation
***D.** Sun

Multiple Choice 33 **Difficulty – 0.500**

Energy is produced on the sun through the process of

***A.** fusion
B. fission
C. combustion
D. photosynthesis

Use the following diagram to answer the next question.



Numerical Response 10 **Difficulty – 0.267**

Rank the following according to increasing use of solar radiation.

1 – driving the water cycle
2 – initiating photosynthesis
3 – driving air and water currents
4 – reflected by clouds, dust, and earth’s surface

Answer:

________ ________ ________ ________

(Record your answer in the numerical-response section of the answer sheet.)

Answer – 2314

The next four questions deal with the following location.

The second possible location for your self-sufficient station is on the prairies where the available energy sources are wind, solar radiation, and biomass.

Multiple Choice 34 **Difficulty – 0.453**

The generation of wind power originates in

- ***A.** the sun
- **B.** magnetic fields
- **C.** electrical fields
- **D.** gravitational fields

Multiple Choice 35 **Difficulty – 0.233**

Which environmental impact would you give the highest priority when recommending the construction of a wind-powered electrical station in a residential area?

A. Electrical transmission lines will emit EMR
B. The metal blades would appear unattractive
C. Interference with radio communications
***D.** Noise pollution

The next three questions deal with the following information.

Biomass may provide energy directly through combustion or indirectly through fermentation into methane that is then burned.

Multiple Choice 37 **Difficulty – 0.519**

What is the molar heat of combustion for methane based on the reaction equation 1 $CH_{4(g)}$ + 2 $O_{2(g)} \rightarrow$ 1 $CO_{2(g)}$ + $2HO_{2(g)}$?

A. –560.5 kJ/mol
B. –710.1 kJ/mol
***C.** –802.3 kJ/mol
D. –951.9 kJ/mol

The next four questions deal with the following location.

The third possible location for the alternate energy station is a coastal region. In this location, tides and solar radiation would be the available energy sources.

Multiple Choice 39 **Difficulty – 0.760**

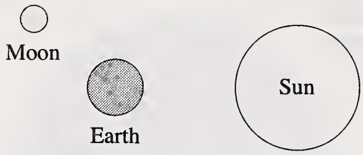
The generation of tides can best be explained by

A. inertia of water
B. centrifugal force
C. electrostatic fields
***D.** gravitational fields

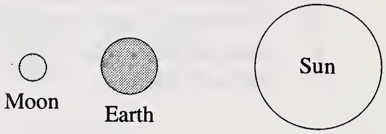
Multiple Choice 40 **Difficulty – 0.496**

Twice a month, a spring tide (very high and very low water levels) occurs. Which diagram explains this event?

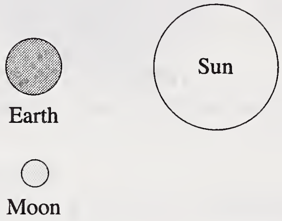
A.



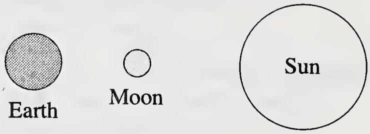
B.



C.



***D.**



Multiple Choice 41 **Difficulty – 0.554**

The sun and moon interact to produce tides. Which has the greater influence?

- ***A.** The moon because it is closer
- **B.** The sun because of its greater mass
- **C.** Equal influence because of size and distance
- **D.** The moon because it is solid rather than gaseous in nature

The student achieving the *standard of excellence* can do the following types of questions:

Numerical Response 7 **Difficulty – 0.287**

Scientists decide to power the space station by using silicon photovoltaic cell panels to capture the solar energy radiated by the sun. The solar energy available at this point in space is 3.20×10^3 J/m^2 per second. How much energy is available for capture by a 1.00 m × 1.50 m panel in one second? Express your answer to three digits.

Answer: __________ $\times 10^3$ J.

(Record your answer in the numerical-response section of the answer sheet.)

Answer – 4.80

Numerical Response 9 **Difficulty – 0.039**

The scientists on the space station decide to replenish their oxygen supply by using the electrolysis of water.

$$2H_2O_{(l)} \xrightarrow{\text{electrical energy}} 2H_{2(g)} + O_{2(g)}$$

Use heats of formation to determine how much electrical energy must be supplied to produce 10.00 moles of $O_{2(g)}$. Express your answer to four digits.

Answer: __________ kJ.

(Record your answer in the numerical-response section of the answer sheet.)

Answer – 2858

Use the following information to answer numerical response question 11.

Energy conversions

1 – thermal
2 – solar
3 – electrical
4 – mechanical

Numerical Response 11 **Difficulty – 0.450**

List the sequence of energy conversions used to generate electricity from wind.

Answer:

___________ ___________ ___________ ___________

(Record your answer in the numerical-response section of the answer sheet.)

Answer – 2143

Multiple Choice 36 **Difficulty–0.109**

Currently, the lowest mean annual wind speed from which turbines can economically extract energy is about 5 m/s. Given that the wind energy varies directly as the cube of the wind speed, a mean annual wind speed of 10 m/s would multiply the amount of energy available by

A. 2
B. 3
C. 6
***D.** 8

The next two questions deal with the following information.

Biomass may provide energy directly through combustion or indirectly through fermentation into methane that is then burned.

Numerical Response 12 **Difficulty – 0.043**

How much useful energy would be released if 10.00 mol of methane was burned in a mid-efficiency (78%) furnace. Express your answer to four digits.

Answer: ____________ kJ.

(Record your answer in the numerical-response section of the answer sheet.)

Answer – 6238

Multiple Choice 38 **Difficulty – 0.391**

Which energy conversion pathway is most efficient in providing hot water?

***A.** Solar to thermal
B. Wind to electrical to thermal
C. Combustion of coal to hydroelectric to thermal
D. Methane production (composting) to methane combustion to thermal

Multiple Choice 42 **Difficulty – 0.566**

Which path best represents the conversion of tidal energy into electrical energy?

A. Solar → kinetic (water) → mechanical → electrical
B. Gravitational potential → kinetic (water) → thermal → electrical
C. Geothermal → kinetic (water) → mechanical → thermal → electrical
***D.** Gravitational potential → kinetic (water) → mechanical → electrical

Appendix A Calculator Policy

POLICY: USE OF CALCULATORS ON ALBERTA EDUCATION DIPLOMA EXAMINATIONS

Background

The knowledge, skills, and attitudes relevant to technology and its uses are being incorporated into courses and programs of study wherever appropriate. Students are expected to learn the advantages and limitations of technological developments and their impact upon society. The ability to use technology helps students understand and appreciate the process of technological change, gives added depth to programs, and provides the basis for the development of skills and understanding. These expectations are reflected in the diploma examinations. Since the data provided for writing diploma examinations in mathematics and the sciences do not include information such as logarithms and trigonometric functions, students will need to use scientific calculators for these exams.

Definition

This policy considers a scientific calculator to be a hand-held device designed primarily for mathematical computations. Included in this definition are those scientific calculators having graphing capabilities, built-in formulas, mathematical functions, or other programmable features.

Policy

To ensure compatibility with provincial *Programs of Study* and equity and fairness for all students, Alberta Education expects students to use scientific calculators, as defined above, when they are writing diploma examinations in mathematics and the sciences. Examinations are constructed to ensure that the use of particular models of calculators neither advantages nor disadvantages individual students.

Procedures

1. Teachers must, at the beginning of a course, advise students of the types of calculators that they may use when writing diploma examinations in mathematics and the sciences. Teachers must also advise students of the types of information that can be stored in calculators that are brought into diploma examinations.

2. Students must clear calculators that are brought into diploma examinations of all information previously stored except for
    a. programs used for computing values of the formulas that are provided on the diploma examination tear-out pages or in a separate data booklet for the subject being written,
    b. programs used for Quadratic Relations as found in the Mathematics 30/33 Interim Teacher Resource Manual.

3. Students must not bring external devices to support calculators into the exam. Such devices include manuals, printed or electronic cards, printers, memory expansion chips or cards, external keyboards, or any annotations outlining operational procedures for scientific calculators.

4. In preparation for calculator failure, students may bring extra calculators and batteries into the exam room.

5. During exams, supervising teachers must ensure that
    a. all calculators operate in silent mode,
    b. students do not share calculators or information contained within them,
    c. calculator cases are stored on the floor throughout the exam, and
    d. all examination rules are followed.

6. If you have any questions or comments about the implementation of this policy, please contact the Math/Science Unit, Student Evaluation Branch, at 403-427-0010 or FAX 403-422-4200.

Revised 19 September 94

Examination Rules

GRADE 12 DIPLOMA EXAMINATIONS

1. **Admittance to the Examination Room**
   Students must not enter or leave the examination room without the consent of the supervising teacher.

2. **Student Identification**
   Students must present identification that includes their signature and photograph. One of the following documents is acceptable: driver's licence, passport, or student identification card. Students must not write an examination under a false identity or knowingly provide false information on an application form.

3. **Identification on Examinations**
   Students must not write their names or the name of their school anywhere in or on the examination booklet other than on the back cover.

4. **Time**
   Students must write an examination during the specified time and may not hand in a paper until at least one hour of the examination time has elapsed. Students who arrive more than one hour after an examination has started will not be allowed to write the examination. Students who arrive late but within the first hour of an examination sitting may be allowed to write only at the discretion of the supervising teacher.

5. **Discussion**
   Students must not discuss the examination with the supervising teacher unless the examination booklet is incomplete or illegible. Students must not talk, whisper, or exchange signs with one another.

6. **Answer Sheets**
   Students must use an HB pencil to record their answers on the machine-scorable answer sheets.

7. **Written Responses**
   All work for the written-response sections of the diploma examinations must be done in the examination booklet. Students are expected to write their revised work in blue or black ink for English 30, English 33, Français 30, and Social Studies 30.

8. **Material Exchanges**
   Students must not copy from other students or exchange material. Notes in any form—including those on papers, in books, or stored in electronic devices—must not be brought into the examination room. Calculator programs designed to perform mathematical computations or those designed to assist students in graphing are not classified as notes (see *Calculator Policy*).

9. **Materials Allowed**
   English 30, English 33: Students may use a dictionary and a thesaurus for Part A only. Electronic devices are not allowed for either part.
   Français 30: Students may use a dictionary, a thesaurus, and a book of verb forms for Partie A only. Electronic devices are not allowed for either part.
   Social Studies 30: Students may not use electronic devices.
   Biology 30, Mathematics 30, Physics 30: Tear-out data pages are provided in the examination booklet. Students need to use scientific calculators (see *Calculator Policy*) but must not share them.
   Chemistry 30, Science 30 (Pilot): A separate data booklet is provided for each of these examinations. Students need to use scientific calculators (see *Calculator Policy*) but must not share them.

   Students are expected to provide their own writing materials, including pens and HB pencils, calculators, or other necessary instruments. Tear-out pages for rough work are provided in each biology, chemistry, mathematics, physics and science (pilot) examination booklet.

10. **Translation Dictionaries**
    Students are not allowed to use translation dictionaries in any subject. Exchange students must satisfy the same requirements as other students.

Students First!
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Appendix C

Guidelines for Significant Digits, Manipulation of Data, and Rounding in the Mathematics and Sciences Diploma Examinations

Significant Digits

1. For all non-logarithmic values, regardless of decimal position, any of the digits 1 to 9 is a significant digit; 0 may be significant. For example:

   123 0.123 0.00230 2.30×10^3
   all have 3 significant digits

2. Leading zeros are not significant. For example:

   0.12 and 0.012 each have two significant digits

3. Trailing zeros to the right of the decimal are significant. For example:

   0.123 00 and 20.000 each have five significant digits

4. Zeros to the right of a whole number are considered to be ambiguous. **The Student Evaluation Branch considers all trailing zeros to be significant**. For example:

   200 has three significant digits

5. For logarithmic values, such as pH, any digit to the left of the decimal is **not** significant. For example:

   a pH of 1.23 has two significant digits
   a pH of 7 has no significant digits

Manipulation of Data

1. When adding or subtracting measured quantities, the calculated answer should be rounded to the same degree of precision as that of the least precise number used in the computation **if this is the only operation**. For example:

   12.3 (least precise)
   0.12
   12.34
   24.76

   The answer should be rounded to 24.8.

2. When multiplying or dividing measured quantities, the calculated answer should be rounded to the same number of significant digits as are contained in the quantity with the fewest number of significant digits **if this is the only operation**. For example:

   (1.23)(54.321) = 66.81483

   The answer should be rounded to 66.8.

3. When a series of calculations is performed, each interim value should not be rounded before carrying out the next calculation. The final answer should then be rounded to the same number of significant digits as are contained in the quantity with the fewest number of significant digits. For example:

   In determining the value of (1.23)(4.321)/(3.45 – 3.21), three calculations are required:

   a. 3.45 – 3.21 = 0.24

   b. (1.23)(4.321) = 5.31483

   c. 5.31483/0.24 = 22.145125

   [Not 5.31/0.24 = 22.125]

   The value should be rounded to 22.1.

Rounding

1. When the first digit to be dropped is less than or equal to 4, the last digit retained should not be changed. For example:

   1.2345 rounded to three digits is 1.23

2. When the first digit to be dropped is greater than or equal to 5, the last digit retained should be increased by one. For example:

   12.25 rounded to three digits is 12.3

Appendix D

Explanations of Cognitive Levels

Knowledge refers to those behaviours and test situations that emphasize the remembrance, either by recognition or recall, of ideas, material, or phenomena.

Comprehension refers to responses that demonstrate an understanding of the literal message contained in a communication.

Application requires the student to apply an appropriate abstraction (theory, principle, idea, method) to a new situation.

Analysis comprises the ability to recognize unstated assumptions, to distinguish facts from hypothesis, to distinguish a conclusion from statements that support it, to recognize facts or assumptions that are essential to a main thesis, to distinguish cause-effect relationships from other sequential relationships, and to recognize a writer's viewpoint.

Synthesis is the production of a unique communication. It is the ability to propose ways of testing hypotheses, the ability to design an experiment, the ability to formulate and modify hypotheses, and the ability to make generalizations.

Evaluation is defined as making judgements about the value of ideas, solutions, and methods. It involves the use of criteria to appraise the extent to which details are accurate, effective, economical, or satisfying. Evaluation includes the ability to apply given criteria to judgements of work done, to indicate logical fallacies in arguments, and to compare major theories and generalizations.

Directing Words

Discuss
The word "discuss" will not be used as a directing word on math and science diploma examinations because it is not used consistently to mean a single activity.

The following words are specific in meaning. The corresponding cognitive levels are enclosed in parentheses.

Contrast/Distinguish
Point out the *differences* between two things that have similar or comparable natures. (Analysis)

Compare
Show the character or relative values of two things by pointing out their *similarities* and *differences*. (Analysis and/or Evaluation)

Conclude
State a logical end based on reasoning and/or evidence. (Evaluation)

Criticize
Point out the *merits* and *demerits* of an item or issue. (Analysis and Evaluation)

Define
Provide the essential qualities or meaning of a word or concept. Make distinct and clear by marking out the limits. (Knowledge)

Describe
Give a written account of or represent the characteristics by a figure, model, or picture. (Knowledge)

Design/Plan

Construct a plan, i.e., a detailed sequence of actions, for a specific purpose. (Application and/or Synthesis)

Enumerate

Specify one by one or list in concise form and according to some order. (Knowledge)

Evaluate

Give the significance or worth of something by identifying the good and bad points or the advantages and disadvantages. (Analysis and Evaluation)

Explain

Make clear what is not immediately obvious or entirely known; give the cause of or reason for; make known in detail. (Comprehension)

How

Show in what manner or way, with what meaning. (Comprehension)

Hypothesize

Form a tentative proposition intended as a possible explanation for an observed phenomenon; i.e., a possible cause for a specific effect. The proposition should be testable logically and/or empirically. (Analysis and Synthesis)

Identify

Recognize and select as having characteristics of. (Knowledge)

Illustrate

Make clear by giving an example. The form of the example must be specified in the question; i.e., word description, sketch, or diagram. (Comprehension and/or Application)

Infer

Form a generalization from sample data; arrive at a conclusion by reasoning from evidence. (Evaluation)

Interpret

Tell the meaning of; present information in a new form that adds meaning to the original data. (Comprehension)

Justify/Show How

Show reasons for or give facts that support a position. (Evaluation)

Outline

Give, in an organized fashion, the essential parts of. The form of the outline must be specified in the question; i.e., lists, flow charts, concept maps. (Knowledge and/or Comprehension)

Predict

Tell in advance on the basis of empirical evidence and/or logic. (Application)

Prove

Establish the truth, validity, or genuineness of something by giving factual evidence or logical reasons. (Evaluation)

Relate

Show logical or causal connection between. (Analysis)

Solve

Give a solution for a problem, i.e., explanation in words and/or numbers. (Analysis and Synthesis)

Summarize

Give a brief account of the main points. (Comprehension)

Trace

Give a step-by-step description of the development. (Knowledge)

Why

Show the cause, reason, or purpose. (Comprehension and/or Synthesis)

Appendix E

Preparing to Write a Science Diploma Examination—What every student should do before the examinations!

1. Prepare a course review schedule:
   - design your schedule for the two-week period (minimum) before the examination
   - divide the course material into sections and indicate on the schedule the time blocks to be devoted to each section
     - take into account the examination blueprint available from your teacher (*Diploma Examinations Program Information Bulletin* for the course). Note that course units are not equally weighted on the diploma examination
     - take into account units/concepts that you find most difficult; i.e., allocate more time for the review of these

2. Obtain and review examination schedules, rules, and policies:
   - record the time and place of writing
   - note minimum and maximum writing times permitted
   - prepare to remain in the examination room for at least 2.5 h (Kleenex, cough drops, etc.)
   - identify materials allowed for writing each examination, such as pencils, pens, calculators, mathematical instruments, and clear plastic ruler

3. Identify and collect examples of each type of question that will be asked:
   - obtain a copy of the relevant information contained in the *Diploma Examinations Program Information Bulletin* for the course (available from your teacher)
   - review the format of previous diploma examinations (available from your teacher)
   - learn the meanings of key "directing" words such as compare, describe, evaluate, explain, illustrate, interpret, justify, prove, and solve

4. Make summaries and point form outlines:
   - distinguish between major concepts and factual details
   - identify essential skills that can be assessed on paper and pencil tests
   - review lab results and procedures—identify connections between lab reports, class notes, and textbook
   - anticipate examples of connections between concepts and the "real world"
   - prepare a glossary of important subject terminology
   - review the data booklet for Chemistry 30 or Physics 30, and review formulas and equations if applicable
   - link each formula or equation with a calculation done on a previous test or assignment
   - identify any restriction on the use of each formula or equation

5. Use memory aids such as:
   - colour coding, underlining, highlighting, jotting keywords in margins
   - numbering points to be memorized
   - grouping word and idea associations
   - reading aloud key words, expressing key words in your own words

6. Review the different question formats and the instructions on how to answer these questions.

Appendix F

Suggestions for Students When Writing Science Diploma Examinations—What every student should know when writing examinations!

1. Do not be afraid to answer each question even if you are not sure of the correct solution to the problem. A penalty is NOT given for guessing on the machine-scored section the exam. Partial marks are often awarded for incomplete answers in the written-response section of the exam.

2. If you are stuck on a question, mark the alternatives that you know are incorrect and choose from the ones that are left using logical guessing strategy. Think of the questions as challenges and cultivate a positive attitude about your ability to answer them.

3. Scan the sets of questions of the examination before answering a particular question. The questions in one set of the examination may jog your memory about a question in another set. .

4. When first reading a multiple-choice question, locate and circle key words to help clarify the meaning of the question. Then hide the alternatives and try to formulate an answer of your own. Your answer may be very close to the correct alternative.

5. If a multiple-choice question involves a calculation, do the calculation and select the alternative that is closest to your answer. A multiple-choice calculation is usually short. If you cannot do it in five minutes, your method is either inappropriate or incorrect. Go on.

6. Diagrams on examinations are often labelled with numbers or letters. It may be useful to write in the names of the labelled structures or features that you can identify.

7. When reading graphs, use a clear plastic ruler to more accurately extrapolate or interpolate data.

8. Have a good reason for changing an answer. Do not change an answer on a hunch. Do not waste your time looking for patterns of As, Bs, Cs, or Ds in multiple-choice answers. There are none.

9. You may not have time to write and edit a complete rough copy for each written-response question, but you should prepare an outline of your answer and use it as a guide when writing your good copy.

10. When completing a written-response question, keep in mind the reader of your response. The reader will want to know how well you:
    - understand the problem or the mathematical/science concept
    - can correctly use the mathematics involved
    - can use problem-solving strategies and explain your answer and procedures
    - can communicate your solutions and mathematical/science ideas

11. Rewriting a statement of the question is often a good way to begin a written response. Conclude with a summary statement. Be sure you have clearly explained all assumptions and have verified your conclusions.

12. Keep track of the time and pace yourself. Put a check mark by items that you are uncertain about and return to them if there is time at the end of the examination.

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